ISSN 0717-9901
ISSN ONLINE 0719-0875
Universidad del Bío-Bío



# "REAL OPTIONS IMPLICIT IN THE STRATEGIC DEVELOPMENT OF A FOOD DISTRIBUTION COMPANY"

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## Abstract

The present article focuses in valuate the option of deferring the firm´s expansion through the construction of branches on cities of the south of Chile. It was possible to infer that the real option of postponing an expansion project generates an additional value, due to the benefit of opening before schedule, considering the risk and variability of the sales. In other words, it minimized the exposure to risk by postponing the investing, maximizing the earnings under favourable circumstances

**Keywords**: valuation, firm expansion, deferring, real, options
**JEL Classification**: G12, G13, G31

## Resumen

El presente artículo se centra en valorar la opción de diferir la expansión de la empresa a través de la construcción de sucursales en las ciudades del sur de Chile. Es posible inferir que la verdadera opción de posponer un proyecto de expansión genera un valor adicional, debido a la ventaja de la apertura de sucursales antes de lo previsto, teniendo en cuenta el riesgo y la variabilidad de las ventas. En otras palabras, se reduce al mínimo la exposición al riesgo, al posponer la inversión, maximizando las utilidades bajo circunstancias favorables

**Palabras claves**: evaluación, empresa, expansión, diferir, opciones, reales
**Clasificación JEL:** G12, G13, G31

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ISSN ONLINE 0719-0875
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## 1. INTRODUCTION

The present study focuses on the valuation of a project through real options. It suggests that flexibility provides a value added to it, considering to decide the most appropriate time to expand, given the different potential scenarios in the long term. In particular, let´s go to valuate the option of deferring the expansion strategy through the construction of branches in various cities of the country.

Projects usually require a large budget that is managed according to the capital requirements, which will have a direct effect in the long term. This budget considers the investment decision of the project, such as: the expansion, technological alternatives, replacements of equipments and purchasing and rental decisions, among others Sapag (2007).

The real options were applied to “La Escoba” firm. It is a family owned company with more than 30 years in the business in the south of Chile. The operations of “La Escoba” are the distribution of massive consumption products, mainly food and drink products, as well as cleaning supplies for domestic used to supply small retail stores in the city of Chillan and other neighbouring cities.

Today the competition is very strong due to the massive arrival of large supermarket chains that are leader in this field, the growth of sales has been reduced greatly, as well as the needs of the customers have changed, they have diversified so much so that it is necessary to reengineer the system.

The aim of this article is to identify and assess the implicit real options in the process of expanding a small business. Generally this methodology is applied in large companies, but the risk and operational flexibility are observed in all types of organizations. This article aims to answer several questions: Are there real options projects a small business? Are these options can be assessed? Finally, these options have an impact on the assessment of the project? In the first part we will make a brief description of the methodology, then the presentation of the case study subsequently the application of real options and finally an analysis of the results.

## 2. PROBLEM

### 2.1. Research Method

In this research it is considered specifically a real case of an expansion project of a food product distribution company. The real options methodology is used in order to determine the value added that the expansion decisions provide during a specific period of time, considering the effect of the uncertainty in the variables; Mascareñas et al (2003). The different scenarios are generated through a Monte Carlo simulation, and valued through the NPV. The model avoids complex financially procedures, impropriate for most of the design problems and that constitute barriers to achieve important improvements in the performance which are possible through the exploration of real options. These can be applied easily in a spreadsheet. The analysis implies three main steps:

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1. Set up a spreadsheet to represent the most feasible projections of costs and future incomes of the project. The outcome is a standard economic valuation of an engineering project. The design that maximises the NPV is the basic case with which the flexible solution will be compared, in a way that it will be possible to derive the value of those alternative designs.

2. Present the implications of the uncertainty by simulating the range of potential scenarios. Each scenario leads to a different NPV, and the set of scenarios provides both an "Expected Net Present Value" and a distribution of the potential results of the project. These values are graphed as cumulative distributions that document the Risk Value, that is to say, the possibility that worst cases may occur. This documentation motivates the search for flexibility.

3. Exploring the effects of various alternatives to provide flexibility by changing the costs and the incomes to show these design strategies. The comparison of the expected net present value with the one obtained in the case defines the flexibility value.

### 2.2. Sources and data collection techniques

The main sources of information come from various sources. The Central Bank, The Internal Revenue Service (SII), The Superintendence of Banks and Financial Institutions of Chile (SBIF) and the National Institute for Statistics (INE), as well as, data collected in the first study of this project, with the purpose of finding and estimating the risk and long time sales of the project that would suit it better.

a) *Central Bank:* the free-risk rate ($r_f$) was obtained of the Central Bank Bonds in UF (BCU) dated 17-08-2012 at 10 year of 2.42% which we will use for the estimation of the weighted average capital cost (WACC)

b) *Internal Revenue Service:* Source of information of the market study of the previous research, which in brief measures the market as the number of commercial patents of small or medium size stores in the province, establishing a linear relationship between sales and the number of customers, which is taken to perceptual terms compared to the current market. For example, as seen in table 2.1 Concepción has a relative market of 158% that is to say if in Chillán (Capital of the province of Ñuble) $1000 pesos are sold every year, it is expected that in Concepción $1580 pesos would be sold.

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**Table 2.1** Comparison of the Potential Market per Province

| Province | Market% |
|---|---|
| Arauco | 40% |
| Bio bío | 89% |
| Linares | 94% |
| Concepción | 158% |

Source: *Internal Revenue Service*

c) *Superintendence of Banks and Financial Institutions of Chile:* Information on the monthly evolution of the interest rates was extracted, amount, number of operations in transferable mortgage loans of the financial system for general purposes. With which the property where the building would be build will be financed, the average rate was 4.29% yearly for 8 to 12 years period in the month of April 2012. It is worth mentioning that the average rate of the financial system can be sued as a reference value, since it can vary according to the financial institution. Lastly, it is worth mentioning that the project originally has duration of 10 years.

d) *National Institute of Statistics:* For this study it is vital to obtain a risk measurement; therefore, it was decided to use the Supermarket Index (ISUP). This is a monthly based indicator based on the average of June 1991 that measures the evolution of sales at a commune[3], regional and national level through the information of monthly sales of all Supermarkets with 3 or more cash registers. It is important to mention that the company studied is not listed in our index, to avoid consistency issues.

## 3. METHODS

### 3.1. Costs Estimation

At the time of replicating the project with new branches, the estimated costs for the first branch can also be used if they are corrected according to the capacity, since the same technologies are used and the prices of the materials vary marginally within the scope of the research, according to discussions with the main suppliers of the company.

The necessary research for the good performance of the new branches can be estimated leaving as a main variables the land, warehouse, sales level, for them various prices (costs) are considered per province.

*Capacity Study*

[3] Only the communes of: Antofagasta, Calama, Valparaíso, Viña del Mar, Concepción –Talcahuano, Temuco are incorporated and eleven (11) communities of the Metropolitan Region.

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In general, by establishing a relationship between the demand and the necessary capacity it can be estimated the investment level. This relationship is estimated through the capacity of the warehouse according to the number of pallets that can be stored in the branch.

Considering what was mentioned before, it is noticed that the company has a current maximum capacity of 1015 pallets (Ñuble), also, by establishing a linear relationship between sales and its capacity it can be observed in table 3.1 that Arauco has approximately 40% of the sales in Ñuble (UM$14.237/ UM$35.593 ≈40%); therefore, it is observed that it is needed a 40% of the pallets that are currently used, which translates to approximately 406 pallets (Ecu 1).

| N° de Pallets = Variation % *Pallets Province *(Ecu. 1)* |
|---|

**Table 3.1** Storage Capacity

| Province | Variation % | N° of Pallets |
|---|---|---|
| Arauco | 40% | 406 |
| Bío Bío | 89% | 903 |
| Linares | 94% | 955 |
| Concepción | 158% | 1604 |

Source: self made

These results are set to estimate broadly the number of pallets in each branch and it gives us an idea of the amount of room necessary in terms of storage capacity. Regarding other variables that determine the value of the asset such as technological alternatives, equipment and type of supplies or materials, they remain without variation.

*Branches Layout*

In order to translate the number of pallets into the square meters of the branch, it can be divided into two main areas, the sales floor and the warehouse. As far as the first goes, it has to be considered the necessary room to display the products, following the methodology of the pallets and considering that selling and storing is done in the same racks, it can be infer the following: the number of products remains constant, they can be distributed in 14 racks and adding an area for the products that require refrigeration, as shown in the image below.

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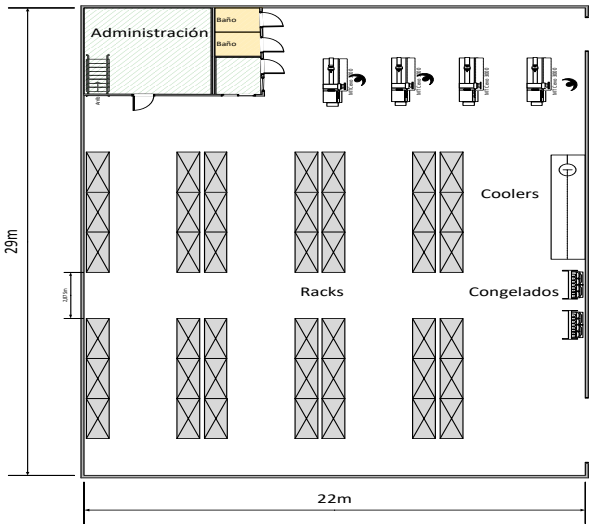
**Image 3.1** Proposal of minimum Sales floor room




Source: self made

In order to estimate the 14 racks, it was considered the following:

- The rags are 7,5 m long and 1 m deep
- There are 3 rows of shelf per rack
- A product needs 0,25 cm long in average to be stored
- Currently, 1200 to 1300 different products are handled

$$N° \; de \; Racks = \frac{1200 \; productos * 0{,}25 \frac{cm}{Producto}}{3 \frac{filas}{rack} * 7{,}5 \frac{m}{fila}} = 13{,}3 \cong 14$$

This area would have a storage capacity of 336 pallets, considering that each rack has 4 storage floors to store pallets (5 in total) and 6 pallets along each rack. Being this a standard sales floor with 638 $m^2$.

Lastly, the necessary warehouse space works based on the difference of the necessary pallets per city. It must also be considered enough room for the reception of goods and 200$m^2$ for a parking lot. Since the former depends on the land available and its dimensions, a real case and a standard one are presented for the other branches.

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All the data regarding capacity and size of the cities considered in the study[4] are summarized in the following table:

**Table 3.2** Storage Capacity

| Item | **Concepción** | **Linares** | **Bío Bío** | Unit |
|---|---|---|---|---|
| Pallets | 1600 | 955 | 903 | U pallets |
| Store size | 1279 | 1100 | 1100 | m2 |
| Field size | 1450 | 1300 | 1300 | m2 |

Source: self made

*Branch Main Investments*

As far as initial investments goes that vary according to the province, the most relevant cost is the land, which for this study will be considered 4,4$UM/m2. This value is established according to a quotation for the highest property price for land (Concepción) within the cities studied; therefore the upper limit is considered so the project is not over valuated.

*Table 3.3 Initial Investment*

| **Initial Investment in Concepción** | | | **Linares** | **Bio Bio** |
|---|---|---|---|---|
| Depreciable Fixed Assets | UM$ | 3.454 | UM$ 5.714 | UM$ 5.714 |
| Non-Depreciable Fixed Assets | UM$ | 6.374 | UM$ 2.945 | UM$ 2.932 |
| GO and PM | UM$ | 129 | UM$ 111 | UM$ 111 |
| Working capital | UM$ | 3.532 | UM$ 2.106 | UM$ 2.178 |
| Total | UM$ | 13.488 | UM$ 10.875 | UM$ 10.935 |

Source: self made

Other Costs

a) Depreciation and Reinvestment: It is considered a linear depreciation with a normal useful life, considering a reinvestment at the last year of the useful life,
b) Operational Costs: In terms of fixed costs, there are considered: Salaries, Inventory, Electricity, Water supply, Telephone, Internet, Fuels, other consumables. Out of the costs mentioned, the most important for the project is the inventory cost, which is

[4] The city of Arauco is not considered, it will be discussed forward in the study

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estimated using the net margin of the company over its inventory, which is equivalent to 13,9% in average; this means that the inventory is going to be based on the estimated demand.

c) GAV: There are considered; Salaries, radio publicity, alarm systems and monitoring, Commercial and alcohol patents.

d) Assets sales: The sale of fixed assets at the end of the period or at any other time during the course of the project is not considered given the cyclical character of the project, it is suggested to continue with the investments already made for future plans of the company. Therefore, the project will be evaluated through what it is capable of generating from this time onward, in other words, it can be estimated the value that any given buyer would be willing to pay for the business at the time of its valuation. For this it is proposed a normal flow as a perpetual average minus the depreciation, as a way to incorporate the effect of the replacement investments necessary to maintain the production capacity (thus the flow) also with an annual perpetual average of this form, the value of the waste is calculated this way:

$$\text{Value} = \frac{(B - C)k - Dep\ k}{i}$$

Where:

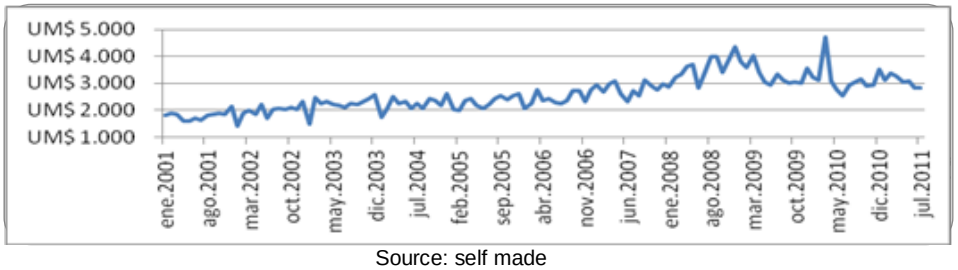
- $(B - C)_k$: Net benefit of the normal year k, or benefits minus cost
- $Dep_k$ :depreciation of the year k
- $i$ :Capital cost rate

3.2. Sales estimation

a) Source of information

There is an historical data base of the monthly sales of the company; which are found in graph 3.1; starting on 2001 and corrected by IPCX base average for the year 2009 and expressed in UM$ to maintain the privacy of the information.

**Graph 3.1**, Total real sales of “La Escoba Firm ” with average base of 2009




Source: self made

It can be observed a constant growth of the sales at a variable pace, after this year and until 2007 the sales increased at a higher rate, which is explained by the world crisis originated

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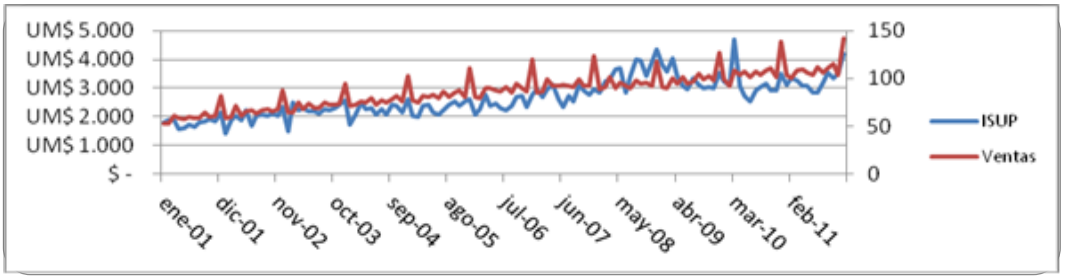
in United States, which started at the end of 2007 and finished at the beginning of 2009. People had a lower budget to satisfy their needs and had to consume alternative products at a lower cost. After this crisis, it was observed an immediate drop in the sales, proving evidence of an improved economical situation of the region. Lastly, it is observed an increment in the sales in March of 2010, which is explained by the earthquake that affected severely the VIII region, due to the fear of a generalized shortage of food product, there was greater consumption in the area.

However, this information is limited and insufficient on its own, since it only considers the local sales in Ñuble and neither it would be adequate to estimate 10 years of the future sales; therefore, it is considered to use the "Supermarket sales index" (ISUP). For two reasons, first as observed in the graph 3.2 there is an strong correlation of Pearson[5] equal to 79,7%.

The ISUP has a 21 years history and considers a national average, thus it has more information. Also, it is suggested that with his indicator it would be possible to generate the greatest estimations of future scenarios, compared to the local sales, if it is considered that this indicator incorporates the effect of variables that affect the sales in other cities.

**Graph 3.2, Total real sales with ISUP**




Source: self made

By observing graphs 3.1 and 3.2, it is possible to notice lineal relations between SALES and the ISUP measured in several units of time from January 2001, since the company has historical records from that date. The first graph shows 132 observations; however they do not meet the assumption of a linear regression despite the apparent relationship, so it is decided to choose an interval of time of one year and reduce the noise, with the inconvenient of the sample is reduced to 11 observations. Despite this, it is decided to choose the second relation, since it presents greater stability and a similar beta.

[5] In statistics, Pearson correlation coefficient is an index that measures the linear relationship between two cumulative random variables

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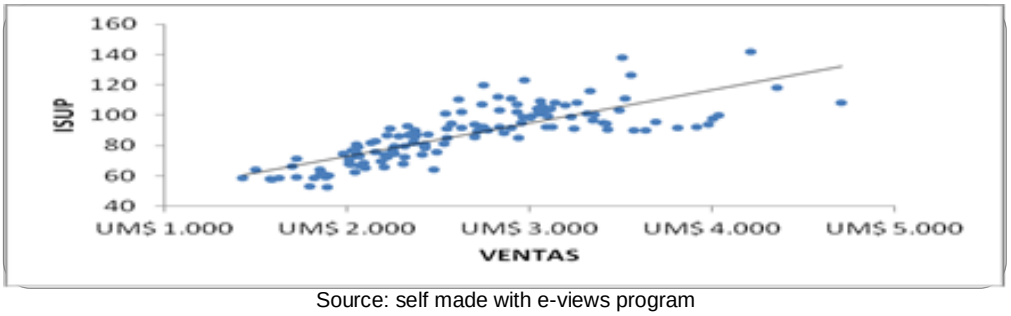
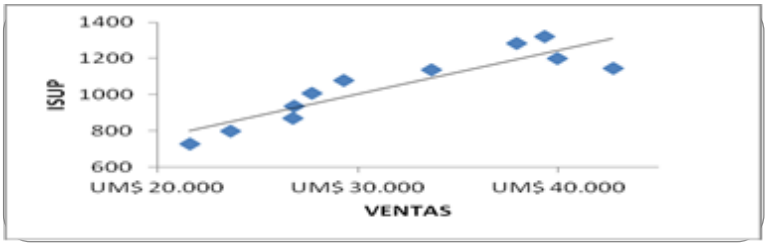
**Graph 3.3 Linear relationships of monthly data. Linear equation: Y = 30.30796X $R^2$ = 0,63**




Source: self made with e-views program

**Graph 3.4 Linear relationships with yearly data. Linear equation: Y = *30,448X* $R^2$ = 0,80**




Source: self made with e-views program

*b) Model and sales estimations*

Considering a relation between these two variables, it could be said that by estimating the future values for the ISUP we would also be estimating future sales for the new branches. In order to do this, the risk of the demand is modelled through the Montecarlo simulation; with this it is necessary to decide what share of probability will be used to estimate the demand. It must be remembered that the objective is to generate random numbers with a distribution, to incorporate it in the model and generate and understand the random variables through time (stochastic processes).

The stochastic model to use will be *Geometric Brownian Motion*, also known as Brownian Motion. It is used to estimate the returns of S&P500, the movement of pollen in water or a man walking in an inebriation state. The exchange rate of an average is Brownian, which is not the case of the subjacent observations, for example, the price of stocks does not necessarily follow the Brownian movement, but their returns do Yuan F (2009). This is used to estimate the behaviour of the price of stocks in financial theory and in other uncertainties.

In math, the Brownian movement is defined as follows

$$VTAS_{t-1} = VTAS_t * e^{\left(\left(\mu - \frac{\sigma^2}{2}\right)T + \sigma * z * \sqrt{T}\right)} \quad \text{(Ecu 2).}$$

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Where the S is the value of the asset, $\mu$ is the trend of the annual return, $\sigma$ is the volatility of the price of the asset, and $dz$ is the "random encounter" applied to $\mu$. In our case in particular the price of the asset would be the sales and the annual return rate the expected growth rate of sales.

Knowing the theoretical model is just the beginning, since it is necessary to calibrate it properly ($\mu, \sigma$); therefore, a linear regression is applied to the series, softened through a natural logarithm, considering an annual period, and the result is shown in graph 3.5, where it is observed that the average annual growth rate is 7,44% and an standard deviation of 5,88.

**Graph 3.5 Relationships with annual data. Linear equation: an = *0,0744x + 5,815* $R^2$ = *0,984***


Source: self made with e-views program

*c) Forecast and validation*

Considering the values of ($\mu$ , $\sigma$) equal to (7,44% 5,88%) and a base ISUP of 1.322,45 points corresponding to last year, a forecast can be generated using the equation 2, generating random numbers through the inverse of the normal cumulative distribution for the specified mean and standard deviation. The results of a 5 years forecasts are found in table 3.4.

$$d\,ISUP = \mu\, ISUP_{2011} dt + \sigma\, ISUP_{2011} dz = ISUP_{2011}(\mu\, dt + \sigma\, dz)$$
$$d\,ISUP = 1322{,}45 * (7{,}44\% + 5{,}88\%) = 12{,}95$$
$$ISUP_{2012} = ISUP_{2011} + d\,ISUP = 1322{,}45 + 12{,}95 = 1335{,}40$$

**Table 3.4** Expected growth. ISUP 2011* Latest value recorded

| Years | ISUP Forecast | Random number of an standardized normal distribution | Growth rate (average annual growth rate + random number * Volatility) |
|---|---|---|---|
| 2011* | 1.322,45 | -1,09839621 | 0,00978922 |
| 2012 | 1.335,40 | -0,61713891 | 0,03809814 |

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| | | | |
|---|---|---|---|
| 2013 | 1.386,27 | 0,73740143 | 0,11777604 |
| 2014 | 1.549,54 | 0,34148105 | 0,09448688 |
| 2015 | 1.695,95 | 0,14389622 | 0,08286438 |

Source: self made

Consequently to these estimations, a validation of the forecast will be conducted for exactness purposes with he values observed, so the values will be considered based on the information collected until 2005 and 6 corresponding values are estimated to the years 2006, 2007, 2008, 2009, 2010 and 2011 as shown in graph 3.6; however, this is just a simulation of the future values of ISUP and by repeating the exercise other scenarios are brought up. Therefore, an average of 3500 simulations is done in order to evaluate the exactness of the model, providing the following results:

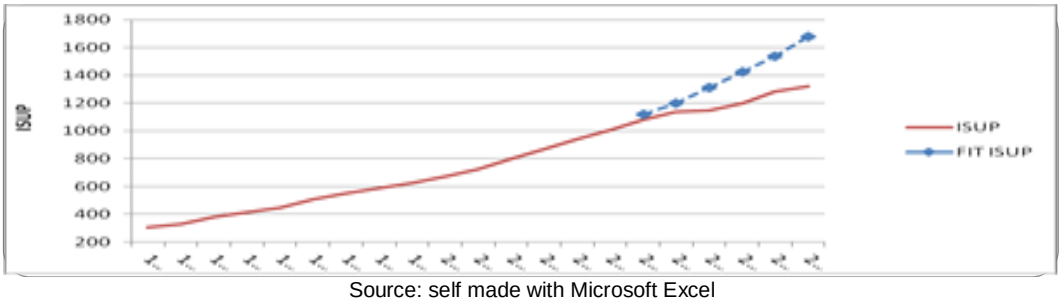
**Table 3.5 Results for forecast test**

| Parameters | Value |
|---|---|
| Standard Deviation | 14,76% |
| Max Standard deviation | 33,40% |
| Min Standard deviation | 1,91% |

Source: self made

As a main conclusion of the validation is that it is not convenient to simulate more than 6 years, given that the error rises as we move on in time. Therefore, for this study, the forecast will be completed through a simulation for 5 years and then a constant ISUP in time will be taken, with the purpose of not over evaluating the project, as shown in graph 3.7.

**Graph 3.6 Forecast simulation tests 2006-2011**




Source: self made with Microsoft Excel

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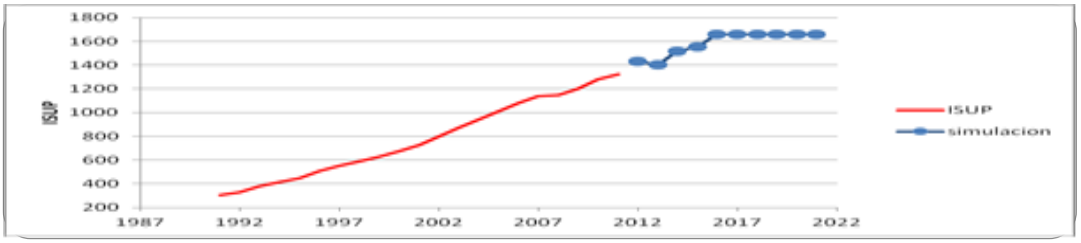
**Graph 3.7 Forecast simulation 20012-2022**




Source: self made with Microsoft Excel

*d) Estimation conclusions*

Lastly, considering the information of previous projects, it is recalled that the learning rate that penalizes sales is a 35% and 17,5% for the first and second year respectively at the time of opening a new branch, also the forecast of the markets per province. Thus, in order to estimate the sales of a store, it has to be forecast first according to the growth rate of ISUP, then the penalty rate is applied, and the market rate is applied, according to the province.

This way, it considered adjustments to the learning rate, the macroeconomic values (ISUP), and the effects of participating in various markets, with efforts to estimate future sales in the new branches.

### 3.3. Estimation of the discount rate

We can visualize it as the weighted average of the costs of the different financing sources used by the company: debt and equity. In this section, we will analyze the estimation of the discount rate using the weighted average capital cost (WACC), in a world with corporate taxes Copeland et al (1983). As mentioned at the beginning of the study, the real discount rate to 100% of the capital (Ks) is 10,83%; however, for this project it is considered to take a credit in order to reduce the discount rate of the project.

a) Degree of leveraging

Considering that currently the company does not have long time debts, or studies related for a proper indebtedness degree in the business field, other foreign and national companies are taken as reference.

In the case of Chile, the information available is found for a company related to the distribution of food products through wholesale supermarkets and retail stores in different formats along the country, which is leveraged at a 41%, according to the last balance of 2011. For the foreign companies it has been considered external information (Damodaran

Aswath[6]), which provides the market value of the indebtedness level, for the companies in the wholesale and retail food industry (Food Whole Salers) divided into various market categories mentioned in the table below:

**Table 3.6 Average of indebtedness (debt/assets), segregated by market**

| Market | Level of indebtedness |
|---|---|
| United States | 29,25% |
| Europe (EU, UK, Switzerland, Scandinavia) | 81,1% |
| Global | 43,0% |
| Emerging Markets | 36,5% |
| India | 11,9% |

Considering the former and that Chile is considered a developing market and the opinions of the current general manager, the level of indebtedness must be between 29,5% and a 35%. Also, if it is considered that a higher indebtedness level can over valuate the project, a 29,5% is chosen as the most appropriate ratio given the information provided so far.

b) Debt cost

In order to estimate this item, the information of the Superintendence of Banks and Financial Institutions of Chile[7] (SBIF) available was used, which provides information of all the transferrable mortgage loans of the financial system, especially regarding weighted average rates, according to the time of the operation, for general purposes. It is considered the information of the last rate available at the time of the study (April 2012) it is a 4,29% real annual for the period between 8 and 12 years, which matches the 10 years duration of the project.

**c)** Wealth average capital cost (WACC**)**

Lastly, considering the equation 3 to estimate the weighted average capital cost, it can be estimated a discount rate, with the information available, applying a 20% first category tax to the project.

$$WACC = k_s * \frac{S}{B+S} + k_d * (1 - \tau_c) * \frac{B}{S+B} \quad \text{(Ecu.3)}$$

[6] Aswath Damodaran. Source: http://pages.stern.nyu.edu/~adamodar

[7] Superintendence of Banks and Financial Institutions, supervises bank institutions, its missions is to oversee the stability and performance of the financial system. www.sbif.cl

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**Table 3.7 WACC estimation summary**

| Item | Value |
|---|---|
| Debt /capital | 41,34% |
| Interest rate ($\tau_c$) | 20,00% |
| Debt cost ($k_d$) | 4,29% |
| % Debt | 29,25% |
| % Capital | 70,75% |
| Capital cost ($k_s$) | 10,85% |
| WACC (real) | 8,68% |

Therefore, under the assumptions and considerations mentioned in this point, it can be considered an annual real rate of 8,68% for the project suggested in the study.

### 3.4. Simulation

The objectives of this point are to generate different scenarios, through a Monte Carlo simulation, a methodology its set up, generation of statistics, graph the main results through histograms and build a cumulative frequency distribution graph of the valuation of the project in each of the various scenarios.

As shown in the following scheme, the simulation is divided into 4 sections, which goes from the generation of the various scenarios to the collection of statistical results.

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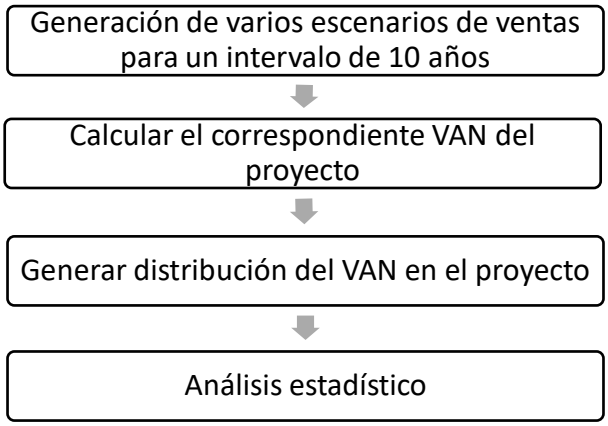


**Image 3.1 Simulation Diagram**

a) Generation of scenarios

As observed in point III.2, sale estimations are generated for each city based on the annual performance estimations of the yearly yield of ISUP, as shown in Table 3.8, applying also the learning adjustments mentioned and the participation in the various markets (Provinces). At this point, it is noted that opening new branches will be completed financed through reinvestments, in other words, the new branches will be financed through the incomes obtained by the new branches, preferring the investment in the largest markets; therefore, the order of investment will be Concepción, Linares and Bio Bío. Arauco is discarded since it is a smaller market; it is out of the research period in the results of the simulations. First, different random numbers must be generated for the various provinces

**Table 3.8 Set of random numbers**

| ***Years*** | ***Random N° ÑUBLE*** | ***Random N° LINARES*** | ***Random N° CONCEPCIÓN*** | ***Random N° Biobío*** |
|---|---|---|---|---|
| 2012 | 0,030 | -0,257 | 0,465 | 1,082 |
| 2013 | 0,042 | -0,117 | 0,470 | -2,714 |
| 2014 | -0,243 | 0,725 | -0,873 | 1,822 |
| 2015 | 0,686 | -2,100 | -0,854 | 0,871 |
| 2016 | 1,280 | 0,122 | -1,252 | -0,142 |

Source: self made with Microsoft Excel

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Then the random numbers are applied to the equation 2 and results generated are shown in table 3.9 as the growth rate expected for the ISUP in that region, it is worth mentioning that sales estimations are conducted for each branch.

**Table 3.9 Growth rate SBIF per city**

| *Years* | Ñuble | Linares | Concepción | Bio Bío |
|---|---|---|---|---|
| 2012 | 7,61% | 5,93% | 10,18% | 13,80% |
| 2013 | 7,69% | 6,75% | 10,20% | -8,53% |
| 2014 | 6,01% | 11,70% | 2,30% | 18,16% |
| 2015 | 11,47% | -4,92% | 2,42% | 12,56% |
| 2016 | 14,97% | 8,16% | 0,07% | 6,60% |

Source: self made with Microsoft Excel

Then sales estimations are conducted and shown in table 3.10, considering the corrections made in point III.2.d; the following demands are estimated.

**Table 3.10 Sales scenarios per city**

| | YEAR | ISUP | Ñuble | Linares | Concepción | Bío Bío |
|---|---|---|---|---|---|---|
| SIMULATIONS | 2012 | 1423 | 42.271 | 40.093 | 45.562 | 40.783 |
| | 2013 | 1533 | 45.490 | 42.800 | 63.729 | 37.306 |
| | 2014 | 1625 | 48.986 | 31.077 | 85.129 | 44.079 |
| | 2015 | 1811 | 51.929 | 37.505 | 87.088 | 49.617 |
| | 2016 | 2082 | 57.887 | 49.170 | 89.192 | 34.381 |
| CONSTANT | 2017 | 2082 | 57.887 | 49.170 | 89.192 | 34.381 |
| | .. | … | … | … | … | … |
| | 2021 | 2082 | 57.887 | 49.170 | 89.192 | 34.381 |

Source: self made with Microsoft Excel

b) Calculate the corresponding NPV of the project

With the sales estimated and the costs associated distributed in point III.1, the accounting flow and cash flows per each city are built, taking the scenario with and without real option in the project. For the scenario without real option, it is considered opening stores under a

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demand in which the average growth per city is considered without the random component and only the constant growth rate previously calculated of 7,44% is applied; therefore, the demand scenario generated is the following.

**Table 3.11 Constant growth rate SBIF per city**

| *Time* | Ñuble | Linares | Concepción | Bío Bío |
|---|---|---|---|---|
| 2012 | 0,0744 | 0,0744 | 0,0744 | 0,0744 |
| 2013 | 0,0744 | 0,0744 | 0,0744 | 0,0744 |
| 2014 | 0,0744 | 0,0744 | 0,0744 | 0,0744 |
| 2015 | 0,0744 | 0,0744 | 0,0744 | 0,0744 |
| 2016 | 0,0744 | 0,0744 | 0,0744 | 0,0744 |

Source: self made with Microsoft Excel

**Table 3.12 Sales scenarios per city at a constant rate**

| | YEAR | ISUP | Ñuble | Linares | Concepción | Bío Bío |
|---|---|---|---|---|---|---|
| SIMULATION | 2012 | 1421 | 1.421 | 40.666 | 44.430 | 38.503 |
| | 2013 | 1527 | 1.527 | 43.692 | 60.587 | 41.368 |
| | 2014 | 1640 | 1.640 | 30.512 | 78.903 | 44.445 |
| | 2015 | 1762 | 1.762 | 41.609 | 84.773 | 47.752 |
| | 2016 | 1893 | 1.893 | 54.187 | 91.080 | 33.348 |
| CONSTANT | 2017 | 1893 | 1.893 | 54.187 | 91.080 | 33.348 |
| | 2018 | 1893 | 1.893 | 54.187 | 91.080 | 33.348 |
| | 2019 | 1893 | 1.893 | 54.187 | 91.080 | 33.348 |
| | 2020 | 1893 | 1.893 | 54.187 | 91.080 | 33.348 |
| | 2021 | 1893 | 1.893 | 54.187 | 91.080 | 33.348 |

Source: self made with Microsoft Excel

Considering the scenario in table 3.12, the branches of Linares and Bio Bío are still open in the 3rd and 5$^{th}$ year respectively, always under the reinvestment rule. These opening dates are used to evaluate the project without real option; however, for comparison purposes, it is used a demand with the randomness variable.

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c) Distribution of the NPV in the project

There are generated 2000 scenarios for the values that can take the NPV of the project (table 3.13) or it is considered a NPV, in the first place of a project with real option ($NPV_1$) and in second place a project without real option ($NPV_2$)

**Table 3.13 Various scenarios of the project**

| ***Scenario*** | ***NPV₁*** | | ***NPV₂*** | |
|---|---|---|---|---|
| 1 | UM$ | 263.707 | UM $ | 164.912 |
| 2 | UM $ | 235.666 | UM $ | 177.152 |
| 3 | UM $ | 206.076 | UM $ | 208.572 |
| 4 | UM $ | 310.933 | UM $ | 148.824 |
| … | UM $ | 284.894 | UM $ | 225.083 |
| | UM $ | 207.325 | UM $ | 222.132 |
| 1999 | UM $ | 191.002 | UM $ | 171.541 |
| 2000 | UM $ | 284.884 | UM $ | 191.696 |

Source: self made with Microsoft Excel

From these various scenarios statistics can be obtained such as the maximum, minimum or average, histograms, cumulative distribution function for both projects, which are presented below:

**Table 3.14 Various scenarios of the project**

| ***Project*** | ***Statistic*** | ***Value*** | |
|---|---|---|---|
| ***NPV₁*** | *Average* | UM$ | 218.379 |
| | *Maximum* | UM$ | 381.684 |
| | *Minimum* | UM$ | 122.685 |
| ***NPV₂*** | *Average* | UM$ | 191.452 |
| | *Maximum* | UM$ | 271.816 |
| | *Minimum* | UM$ | 126.870 |

Source: self made with Microsoft Excel

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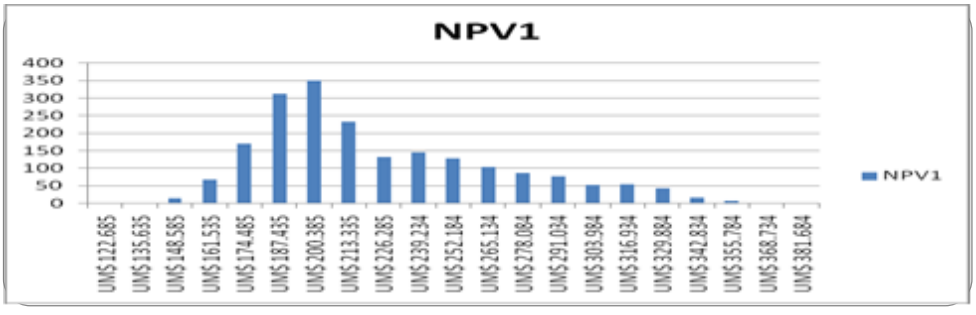
**Table 3.15 Various scenarios of the project**

| | ***Histograms*** | | | |
|---|---|---|---|---|
| | ***NPV1*** | | ***NPV2*** | |
| | Limit (less or equal) | N° Cases | Limit (less or equal) | N° Cases |
| 0 | UM$ 122.685 | 0 | UM$ 126.870 | 0 |
| 1 | UM$ 135.635 | 0 | UM$ 134.118 | 1 |
| 2 | UM$ 148.585 | 14 | UM$ 141.365 | 4 |
| 3 | UM$ 161.535 | 67 | UM$ 148.612 | 18 |
| 4 | UM$ 174.485 | 170 | UM$ 155.859 | 47 |
| 5 | UM$ 187.435 | 313 | UM$ 163.107 | 91 |
| 6 | UM$ 200.385 | 350 | UM$ 170.354 | 157 |
| 16 | UM$ 329.884 | 44 | UM$ 242.827 | 22 |
| 17 | UM$ 342.834 | 17 | UM$ 250.074 | 10 |
| 18 | UM$ 355.784 | 7 | UM$ 257.321 | 5 |
| 19 | UM$ 368.734 | 2 | UM$ 264.569 | 1 |
| 20 | UM$ 381.684 | 1 | UM$ 271.816 | 3 |

Source: self made with Microsoft Excel

**Graph 3.8 Histogram of the project with real option**




Source: self made with Microsoft Excel

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**Graph 3.9 Histogram of the project without real option**

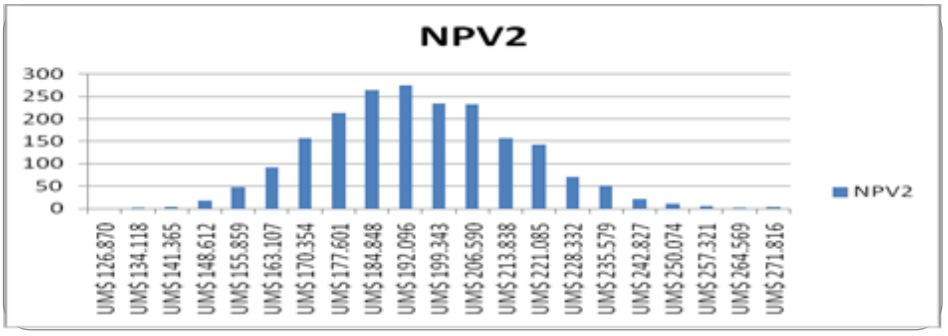


**Table 3.16 Cumulative distribution function**

| | Cumulative Distribution Function | | | | | |
|---|---|---|---|---|---|---|
| | ***NPV1*** | | | ***NPV2*** | | |
| Group | Limit (less or equal) | N° Cases | CDF | Limit (less or equal) | N° Cases | N° Cases |
| 0 | UM$ 122.685 | 1 | 0,05% | UM$ 126.870 | 1 | 0,05% |
| 1 | UM$ 135.635 | 1 | 0,05% | UM$ 134.118 | 2 | 0,10% |
| 2 | UM$ 148.585 | 15 | 0,75% | UM$ 141.365 | 6 | 0,30% |
| 3 | UM$ 161.535 | 82 | 4,10% | UM$ 148.612 | 24 | 1,20% |
| 4 | UM$ 174.485 | 252 | 12,60% | UM$ 155.859 | 71 | 3,55% |
| 5 | UM$ 187.435 | 565 | 28,25% | UM$ 163.107 | 162 | 8,10% |
| 6 | UM$ 200.385 | 915 | 45,75% | UM$ 170.354 | 319 | 15,95% |
| 7 | UM$ 213.335 | 1.148 | 57,40% | UM$ 177.601 | 532 | 26,60% |
| 8 | UM$ 226.285 | 1.281 | 64,05% | UM$ 184.848 | 796 | 39,80% |
| 9 | UM$ 239.234 | 1.426 | 71,30% | UM$ 192.096 | 1.070 | 53,50% |
| 10 | UM$ 252.184 | 1.555 | 77,75% | UM$ 199.343 | 1.305 | 65,25% |
| 11 | UM$ 265.134 | 1.659 | 82,95% | UM$ 206.590 | 1.538 | 76,90% |
| 12 | UM$ 278.084 | 1.745 | 87,25% | UM$ 213.838 | 1.695 | 84,75% |
| 13 | UM$ 291.034 | 1.822 | 91,10% | UM$ 221.085 | 1.837 | 91,85% |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 14 | UM$ | 303.984 | 1.874 | 93,70% | UM$ | 228.332 | 1.907 | 95,35% |
| 15 | UM$ | 316.934 | 1.929 | 96,45% | UM$ | 235.579 | 1.959 | 97,95% |
| 16 | UM$ | 329.884 | 1.973 | 98,65% | UM$ | 242.827 | 1.981 | 99,05% |
| 17 | UM$ | 342.834 | 1.990 | 99,50% | UM$ | 250.074 | 1.991 | 99,55% |
| 18 | UM$ | 355.784 | 1.997 | 99,85% | UM$ | 257.321 | 1.996 | 99,80% |
| 19 | UM$ | 368.734 | 1.999 | 99,95% | UM$ | 264.569 | 1.997 | 99,85% |
| 20 | UM$ | 381.684 | 2.000 | 100,00% | UM$ | 271.816 | 2.000 | 100,00% |

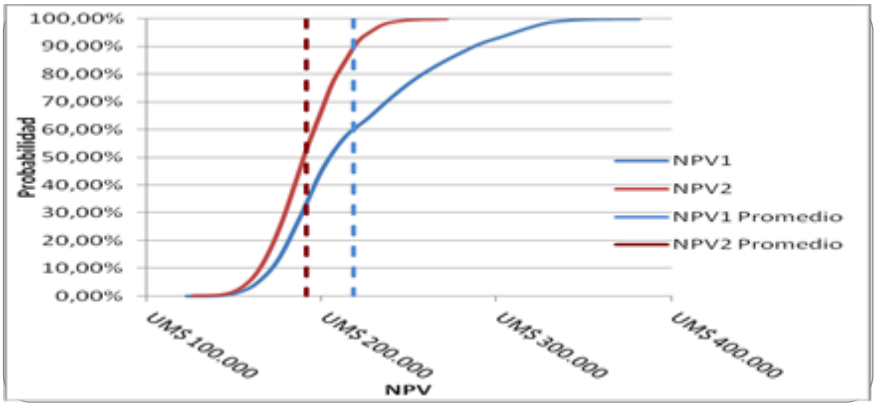
Source: self made with Microsoft Excel

d) Statistical analysis

The analysis is based on the information shown in graphs and tables in the previous points, which compare the valuation scenarios with and without real option.

As observed in table 3.16, both the mean and the maximum of the project with real option is higher, also trough the histogram we can observe that the frequency of the NPVs is displaced towards the right, implying a higher value for the project. This is observed properly if the cumulated distribution function is graphed (graph 3.10) where it is noted clearly that the value of the project is incremented before the growth option.

**Graph 3.10 Function of accumulated distribution**




Source: self made with Microsoft Excel

This shows the positive effect of doing the installation of a branch before expected positive results scenarios or the effect of waiting and defining the moment to open a branch due to sales below the average, which affect the valuation of the project significantly under positive

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ISSN ONLINE 0719-0875
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scenarios; however, that is not the case under less favourable sales scenarios, this way the benefit provided by the real option raises the valuation in average a 40,4%.

## 4. RESULTS AND CONCLUSIONS

First of all, shown a simple methodology through a spreadsheet, to calculate a real option, applied a small company. Also to provide information of the way estimation of incomes, without to need financial assumptions.

It is considered that the real option can be practiced once a year, and it takes one year, once the investments have been made in order to receive the benefits of the project. This is defined this way since despite the expansion decision may be taken at any time, the development of the project takes an estimate of one year, with characteristics of a European option Copeland et al (2001)

It was possible to infer that the real option of postponing an expansion project generates an additional value, mainly due to the benefit of opening an branch before schedule, considering the risk effect and variability of the sales under various scenarios, that is to say, if during the course of the project it is well accepted by the demand (positive scenario), the company expands more aggressively and invest early in new stores, and this way it receives more incomes compared to an scenario that lacks of this option to invest earlier. In other words, it minimized the exposure to risk by postponing the investing, maximizing the potential earnings under favourable circumstances.

Finally, we answered the questions raised at the beginning of the article, we can say, that the real options methodology can be applied to a small business, as it presents the risk characteristics and flexibility, providing greater value to investment decisions.

ISSN 0717-9901
ISSN ONLINE 0719-0875
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